

2011 Massachusetts Periodic Emissions Inventory (PEI)

TRIENNIAL REPORTING TO EPA

SIP INVENTORY REQUIREMENTS

- EPA's 1970 CAA -original SIP requirements of non-attainment areas – 1-hr O₃ (serious) & CO (mod), TSP, Lead
- 1982 SIP
- 1990 CAAA triennial PEI. 9% & 15% Plan.
- 2002 EPA's CERR –electronic reporting - 8-hr O₃ & RH emissions – to EPA-NEI
- Dec 2008 EPA's AERR O₃ & RH pollutants to EPA-NEI.
- 2008 & 2011 PEI to EPA and 2007 base year required for MANE-VU RH modeling.

USES OF EMISSIONS INVENTORY

- SIP Base Year & periodic reporting
- Controls, regulation development
- Projections for O₃ & RH modeling
- RFP & attainment demo
- Emission trends, SIP maintenance plans.
- Transportation Conformity
- Permitting
- Point Sources – Fees, banking & trading

INVENTORY POLLUTANTS

- Ozone SIP: Pollutants -VOC, NOx (& CO) - Summer day
- CO SIP: Pollutant: - CO - winter day
- Regional Haze SIP: Pollutants – VOC, NOx, CO, SO₂, PM10, PM2.5, NH₃ – Annual
- Acid Rain: Pollutant - SO₂ (& NOx) - Annual

EMISSIONS CALCULATION

- Activity Factor (fuel, material, employment, population)
- x emission factor (lb per activity from EPA's AP-42 & other documents)
- x control factor (rule efficiency, rule effectiveness, rule penetration)
- Seasonal adjustment – summer & winter day
- QA

COMPONENTS OF INVENTORY

- 1. STATIONARY POINT
- 2. STATIONARY AREA
- 3. ON-ROAD MOBILE
- 4. OFF ROAD MOBILE
- 5. BIOGENICS

STATIONARY POINT

- Industrial, Power Plants, Commercial & Institutional
- Facilities submit activity data (fuel or material) or emissions, seasonal, daily throughputs, employees, NAICS, equipment type & age etc. to MassDEP Facility Master File (FMF)
- FMF uses EPA's AP-42 emission factors
- EGUs -direct hourly emissions to EPA's CAMD

AREA (Non-Point)

- Too small to be recorded as point sources - collectively high emissions e.g., gas stations, solvents, paints, combustion
- Point sources subtracted if same category - to avoid double counting.
- Some tough categories estimated by EPA and adopted by MassDEP: Biogenics, Wildfires, Wood-burning, Open Burning, PFCs, NH₃ (CMU).

AREA (Non-Point)

- **Waste Management:** POTWS, TSDFs, landfills
- **Gasoline Distrib:** tank-trucks, refueling, PFCs, u.tanks
- **Solvents:** dry clean, degrease, g.arts, adhesives, Non-Indus Surface Coat-autos, AIM paints, Small Indus coatings-furniture, metals, appliances & equip, Misc – asphalt, pesticides, bakeries, breweries, petro spills, etc
- **Fuel Combustion– Res, Comm & Indus:** dist.oil, res.oil, n.gas, wood, kerosene, LPG, biomass & coal. **Fires** – open burning, forest, brush, structural, vehicle, food prep, bbq.
- **Ammonia:** livestock, humans, pets, w.animals, soils, fertilizer - CMU
- **Fugitive Dust:** construction, paved/unpaved roads, mining, agric tilling – EPA estimated category.

ON-ROAD MOBILE

- EPA MOBILE6 Model used until 2005 PEI
- EPA developed MOVES model – several versions since 2008 PEI
- MA submitted MOVES inputs to EPA-NEI to estimate national emissions
- **Inputs:** MassDOT VMT, speeds, Stage II, RVP, monthly temps & humidity, I/M, vehicle mix, age dist, fuel characteristics- ethanol, RFG.

OFF-ROAD MOBILE

- Covers off-road equipment – lawn mowers, Rec boats, construction, ATVs etc.
- Used EPA's NONROAD-08 model.
- **Inputs:** temps, fuel characteristics, RVP, Stage II. Inputs submitted to EPA-NEI
- EPA estimated **Aircraft, Locomotives**, and Commercial **Vessels** some data input from MA.

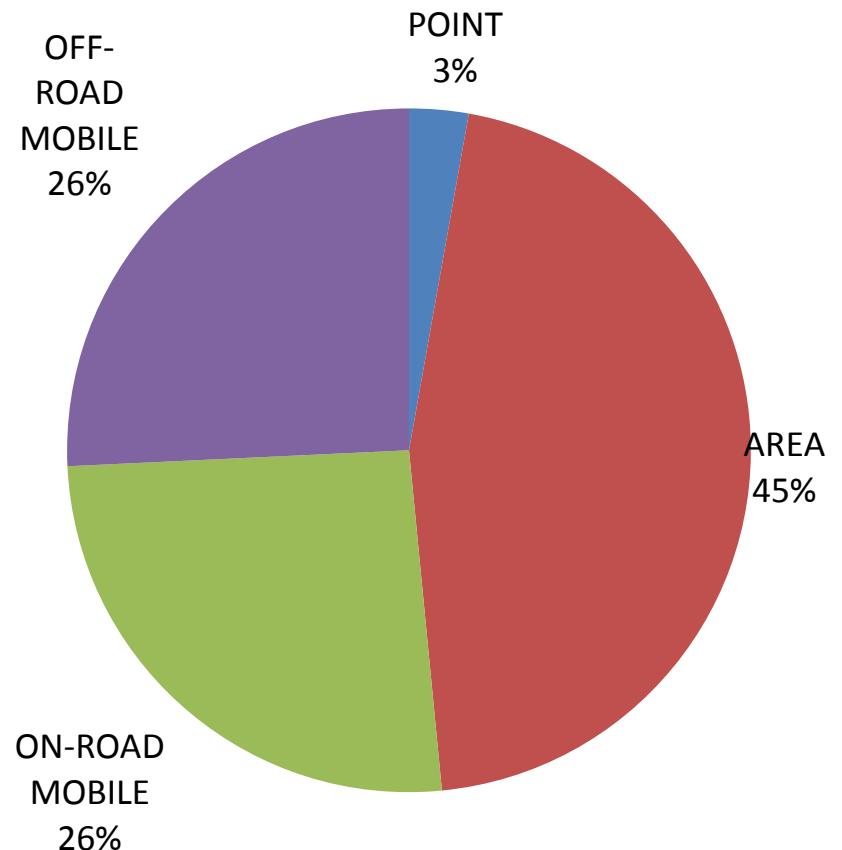
BIOGENICS

- EPA estimates VOC, NOx & CO emissions from vegetation and soils nationally.
- MEGAN and BELD3 canopy Model.

VOC CATEGORIES 2011 tpsd

VOC	VOC TPY	TPY %	TPSD	TPSD %	VOC TPSD
					BIOGENI CS
1 POINT	4,120	2.8%	12.1	2.8%	12.1
2 AREA	73,902	50.9%	197.9	45.7%	198
3 ON-ROAD					
3 MOBILE	37,024	25.5%	111.8	25.8%	112
4 OFF-ROAD					
4 MOBILE	30,250	20.8%	111.6	25.7%	112
5 BIOGENIC S (MEGAN)					380
<i>TOTAL</i>	145,296	100%	433.4	100.0%	813

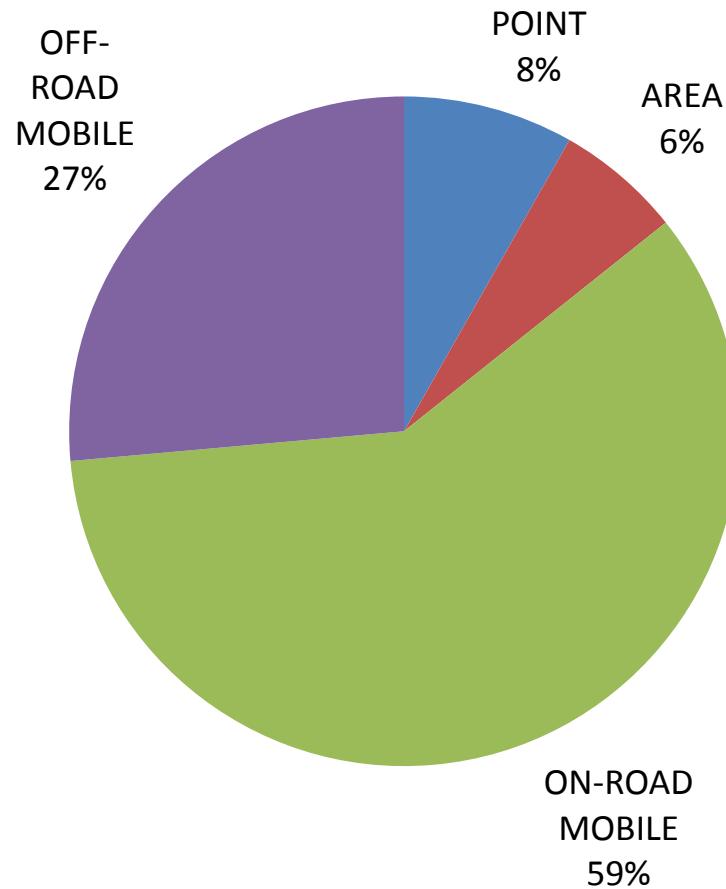
VOC 2011 EMISSIONS (433 TPSD)



NOx CATEGORIES 2011 tpsd

	NOx	NOx TPY	TPY %	TPSD	TPSD %
1	POINT	12,549	8.0%	34.8	8.2%
2	AREA	21,094	13.4%	25.7	6.1%
3	ON-ROAD				
3	MOBILE	90,163	57.2%	251.0	59.3%
4	OFF-ROAD				
4	MOBILE	33,896	21.5%	111.8	26.4%
5	<i>BIOGENICS (BEIS-3)</i>			3.9	
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	TOTAL	157,701	100%	423.3	100.0%

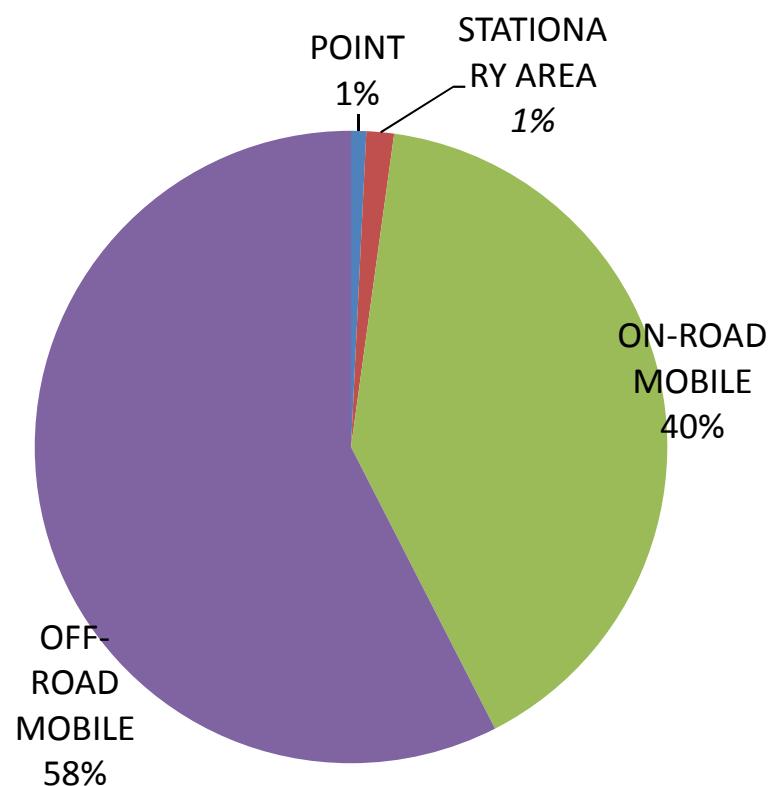
NOx 2011 EMISSIONS (423 TPSD)



CO CATEGORIES tpsd & tpwd

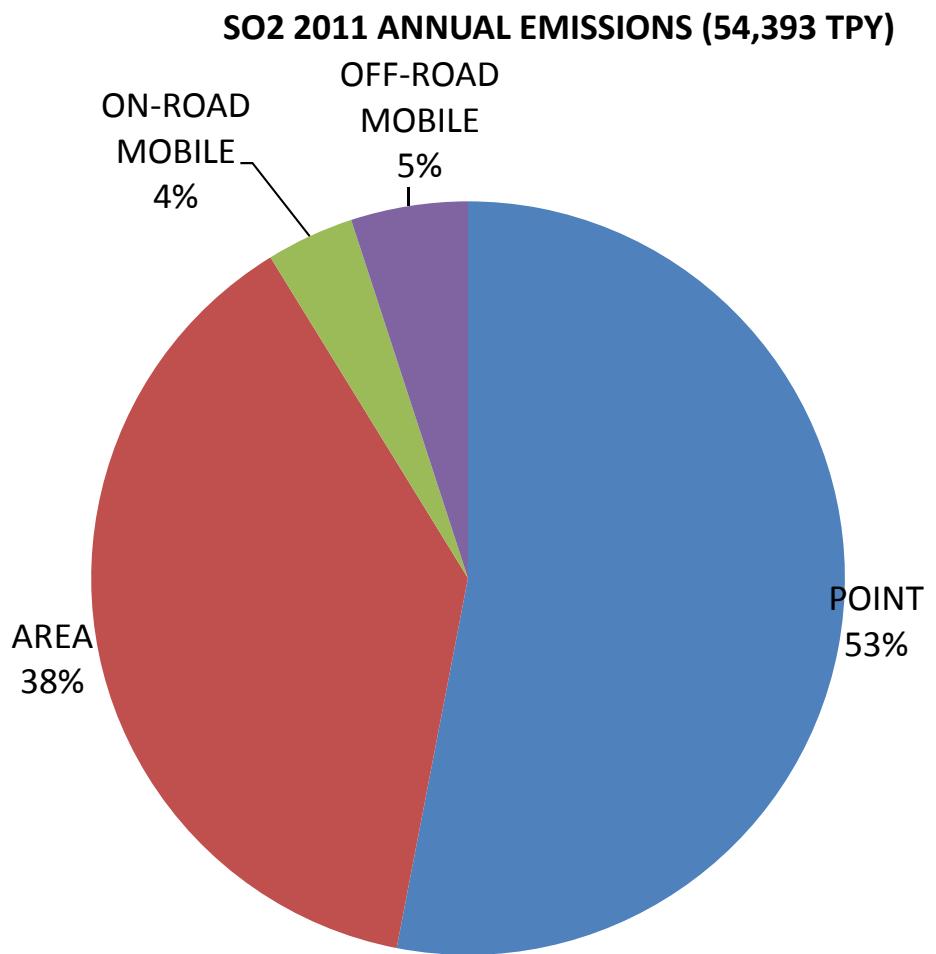
CO	CO TPY	TPY %	TPSD	TPSD %	TPWD	TPWD %
1 POINT	5,905	0.7%	16.6	0.8%	18.4	0.7%
2 AREA	92,386	11.2%	30.2	1.4%	448.9	18.3%
3 ON-ROAD MOBILE	428,396	52.0%	863.7	40.3%	1,481.8	60.3%
4 OFF-ROAD MOBILE	297,495	36.1%	1,232.4	57.5%	507.0	20.6%
Anthropogenic Total	824,182	100%	2,142.9	100.0%	2,456.1	100.0%

CO 2011 SUMMER DAY EMISSIONS (2,143 TPSD)



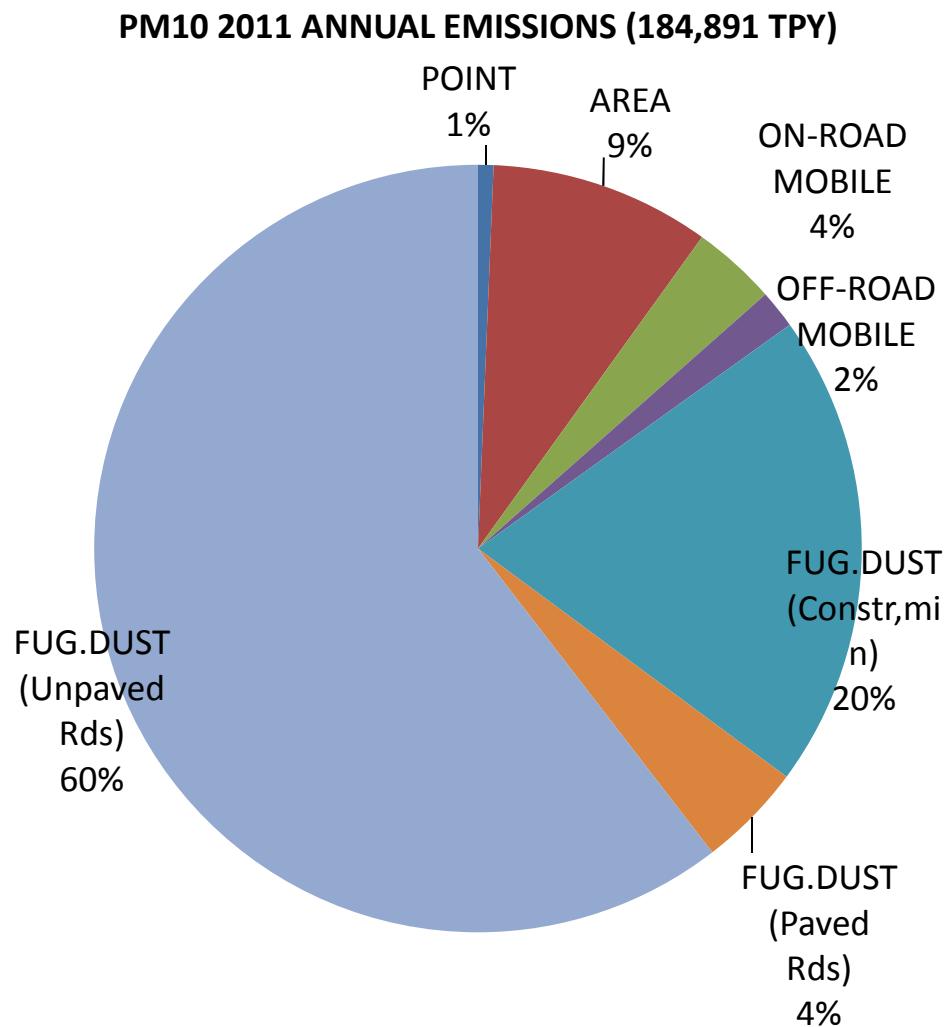
SO2 CATEGORIES 2011 tpy

REGIONAL HAZE POLLUTANTS:			
		<u>SO2 TPY</u>	<u>TPY %</u>
1	POINT	28,848	53.0%
2	AREA	20,765	38.2%
3	ON-ROAD MOBILE	2,048	3.8%
4	OFF-ROAD MOBILE	2,732	5.0%
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	TOTAL	54,393	100%



PM10-pri CATEGORIES 2011 tpy

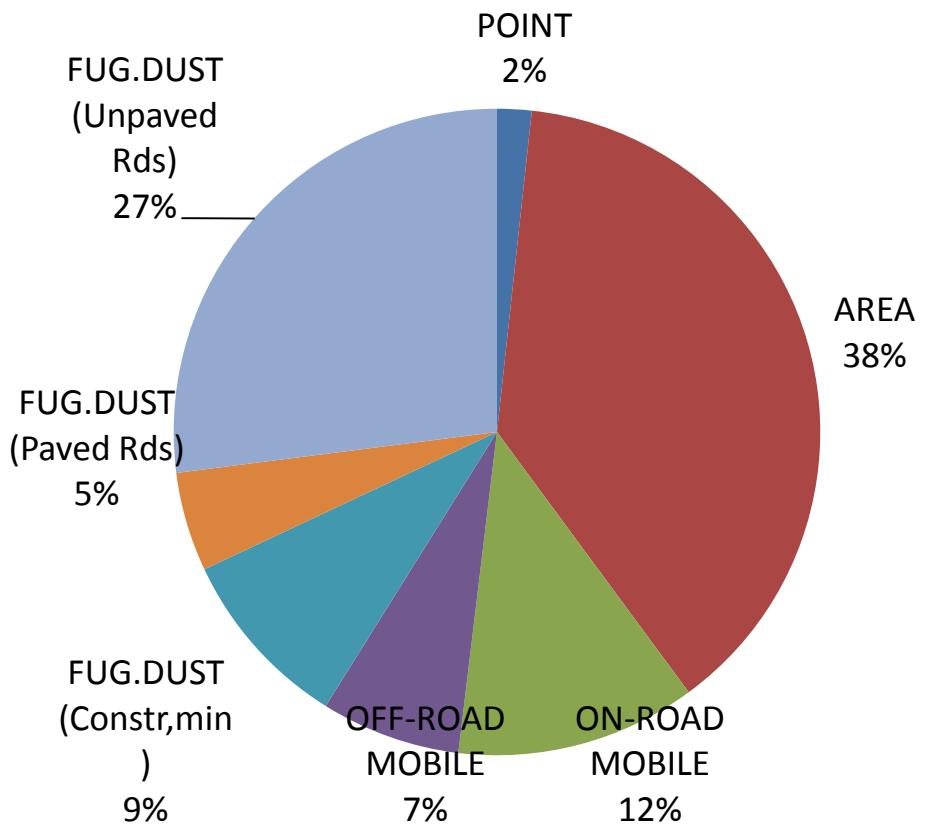
	<u>REGIONAL HAZE POLLUTANTS:</u>	<u>PM10 TPY</u>	<u>TPY %</u>
1	POINT	1,197	0.6%
2	AREA	17,164	9.3%
3	ON-ROAD MOBILE	6,567	3.6%
4	OFF-ROAD MOBILE	2,993	1.6%
5	FUG.DUST (Constr,min)	37,031	20.0%
6	FUG.DUST (Paved Rds)	8,154	4.4%
	FUG.DUST (Unpaved Rds)	111,785	60.5%
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	TOTAL	184,891	100%



PM2.5-pri CATEGORIES 2011 tpy

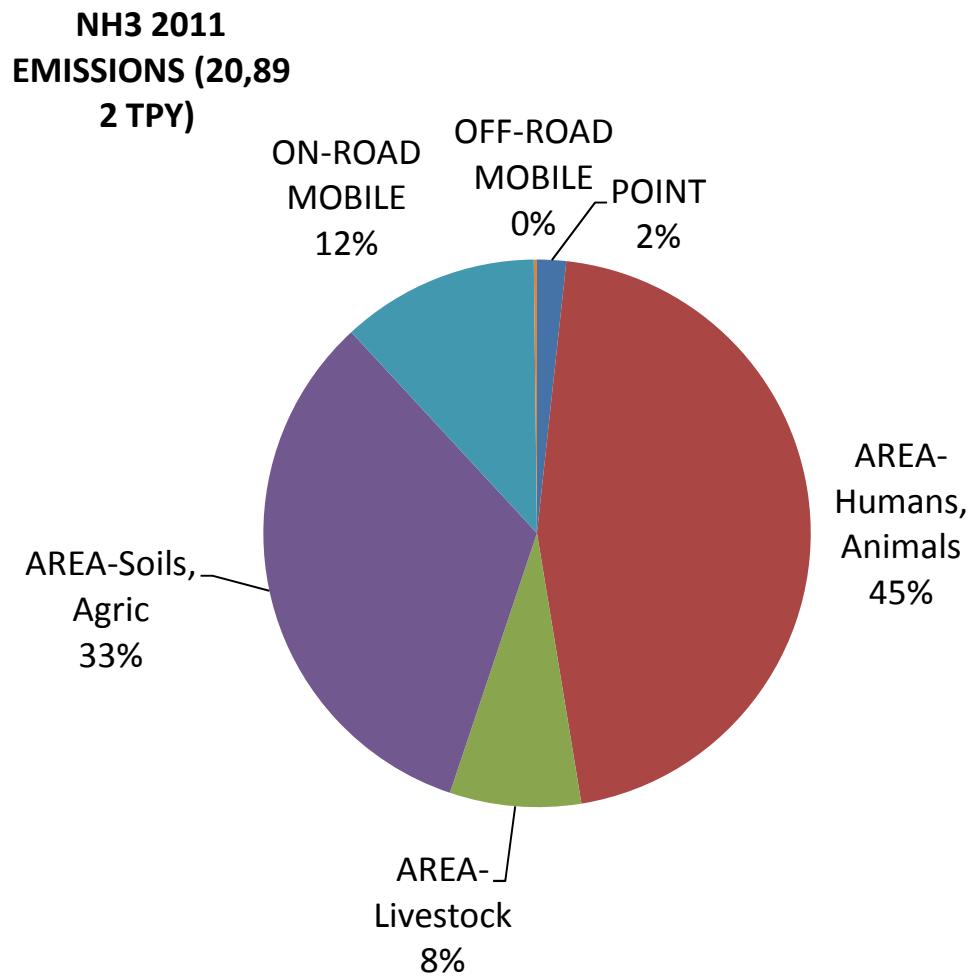
	<u>REGIONAL HAZE POLLUTANTS:</u>	<u>PM2.5 TPY</u>	<u>TPY %</u>
1	POINT	708	1.7%
2	AREA	15,696	38.2%
3	ON-ROAD MOBILE	4,934	12.0%
4	OFF-ROAD MOBILE	2,871	7.0%
5	FUG.DUST (Constr,min)	3,753	9.1%
6	FUG.DUST (Paved Rds)	2,039	5.0%
	FUG.DUST (Unpaved Rds)	11,109	27.0%
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	TOTAL	41,110	100.0%

**FIGURE 1.8 PM2.5 2011 ANNUAL EMISSIONS
(41,110 TPSD)**



NH3 CATEGORIES 2011 tpy

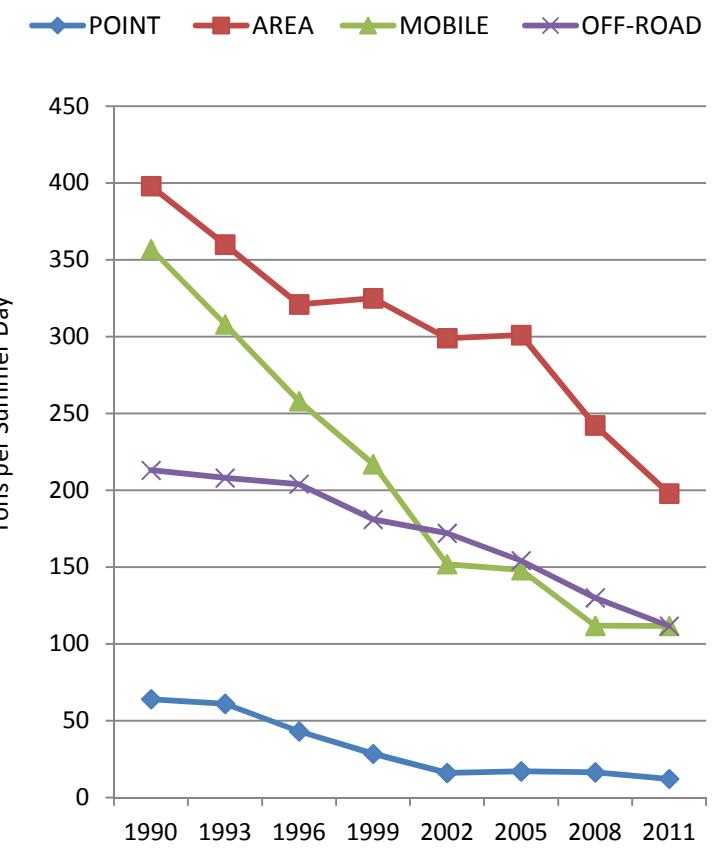
	REGIONAL HAZE POLLUTANTS	NH3 TPY	TPY %
1	POINT	317	1.7%
2	AREA-Humans, Animals	8,399	45.7%
3	AREA-Livestock	1,426	7.8%
4	AREA-Soils, Agric	6,066	33.0%
5	ON-ROAD MOBILE	2,149	11.7%
6	OFF-ROAD MOBILE	33	0.2%
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	TOTAL	18,390	100.0%



VOC TRENDS 1990 – 2011 tpsd

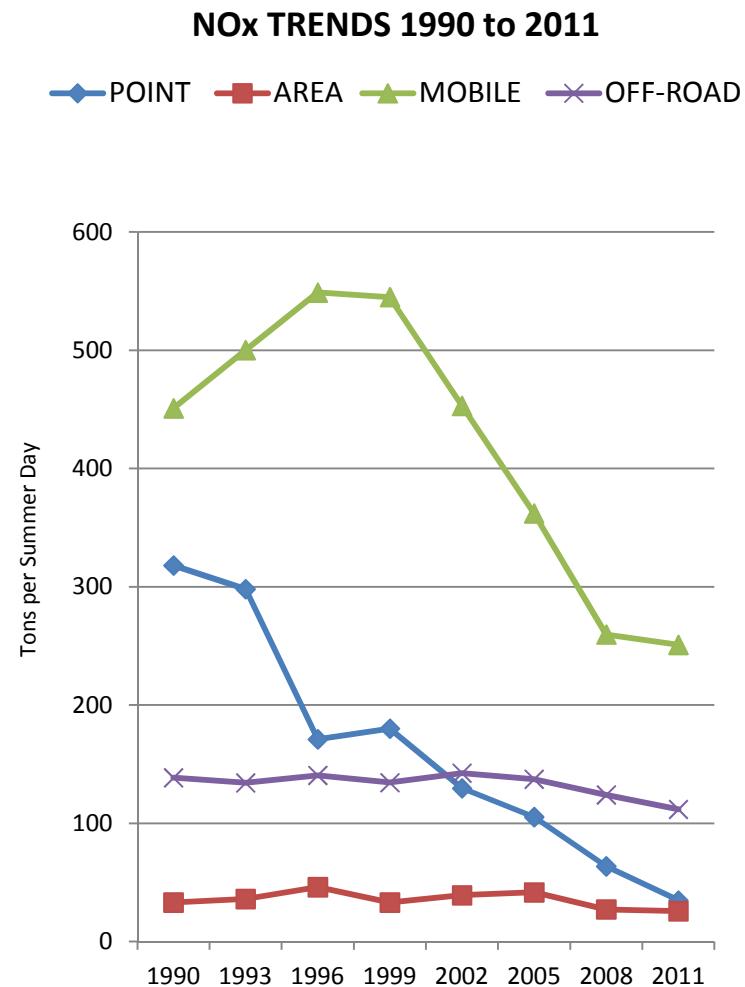
VOC TPSD										%Change
		<u>1990</u>	<u>1993</u>	<u>1996</u>	<u>1999</u>	<u>2002</u>	<u>2005</u>	<u>2008</u>	<u>2011</u>	<u>1990-</u> <u>2011</u>
POINT	64	61	43	28	16		17	16	12	-81%
AREA	398	360	321	325	299		301	242	198	-50%
MOBILE	357	308	258	217	152		148	112	112	-69%
OFF-ROAD	213	208	204	181	172		154	130	112	-48%
TOTAL	1,032	937826	751	639		620	501	433		-58%

VOC TRENDS 1990 TO 2011



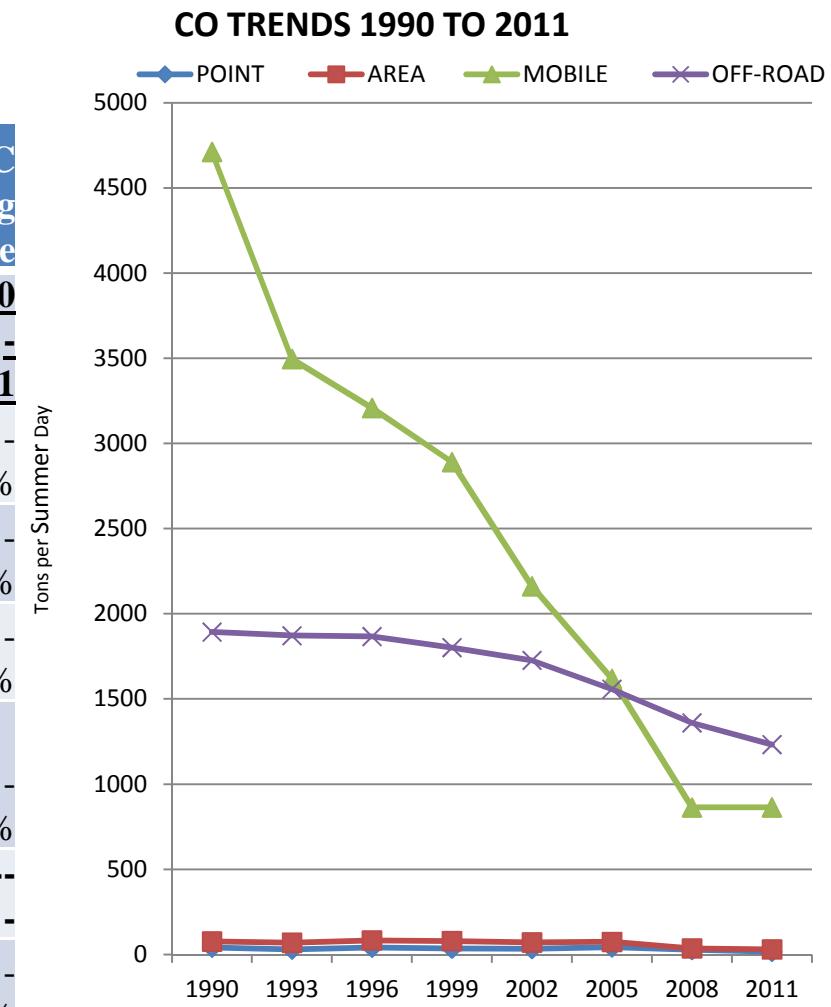
NOx TRENDS 1990 – 2011 tpsd

NOx TPSD											%C hang e
		1990	1993	1996	1999	2002	2005	2008	2011	2011	
POI											
NT	318	298	171	180	130	105	64	35	35	-89%	
ARE											
A	33	36	46	33	39	42	27	26	26	-22%	
MO											
BILE	451	500	549	545	453	362	260	251	251	-44%	
OFF-											
ROA											
D	139	134	141	134	142	137	124	112	112	-19%	
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TOT											
AL	941	968	907	893	764	646	475	423	423	-55%	



CO TRENDS 1990 – 2011 tpsd

	CO TPS D									%C hang e
										<u>1990</u>
		<u>1990</u>	<u>1993</u>	<u>1996</u>	<u>1999</u>	<u>2002</u>	<u>2005</u>	<u>2008</u>	<u>2011</u>	<u>2011</u>
POINT	T	40	29	40	35	33	43	28	17	59%
AREA	A	76	69	83	79	71	74	36	30	60%
MOBILE	ILE	4,712	3,496	3,209	2,891	2,163	1,619	864	864	82%
OFF-ROAD	OD	1,893	1,872	1,867	1,802	1,727	1,558	1,360	1,232	35%
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TOTAL	ALL	6,721	5,466	5,199	4,807	3,994	3,294	2,288	2,143	68%



SO2 TRENDS 1990 – 2011 tpy

	SO2 TPY										%Change	
	<u>1990</u>		<u>1993</u>		<u>1999</u>	<u>2002</u>		<u>2005</u>	<u>2008</u>		<u>2011</u>	<u>1990-2011</u>
POI NT	272,419	210,610		373	125,161,45	9	99,057	92,149	54,547	28,848		-89%
AREA A	80,305	81,652		66	76,9	64,888	25,585	26,952	19,691	20,765		-74%
MOBIL E	10,514	10,608		16	12,1	12,770	4,399	2,936	2,048	2,048		-81%
OFF-ROAD AD	4,658	4,943		4	5,28	5,740	4,262	4,521	2,561	2,732		-41%
TOTAL AL TPY	367,896	307,813		739	219,244,85	133,30	126,55	3	878,847	54,393		-85%

